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The USENIX Association Newsletter

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THE PROFESSIONAL AND TECHNICAL
UNIX® ASSOCIATION

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Members of the UNIX community are encouraged to contribute articles to *login:*. Contributions may be sent to the editors electronically at the addresses above or through the U.S. mail to the Association office. The USENIX Association reserves the right to edit submitted material.

login: is produced on UNIX systems using *troff* and a variation of the *-me* macros. Contributions should be in *n/troff* input format, using any macro package.

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C++ Conference Program

Denver Marriott, City Center Hotel
Denver, Colorado

October 17-20, 1988

USENIX is holding its first full C++ conference in Denver, Colorado, Monday through Thursday, October 17-20.

Program At A Glance / Dates to Remember

- Hotel Registration Deadline September 26
- Pre-registration Deadline September 28
- All Day Tutorials October 17-18
- Technical Sessions October 19-20

For details about registration, contact the USENIX Conference Office immediately.

C++ Tutorial Program

- | | |
|--|-----------------|
| M1: Advanced C++ Topics
Jonathan Shopiro, AT&T Bell Laboratories | Monday, 9-5:00 |
| M2: Object-Oriented Development and C++ Concepts
John Carolan and Adrienne Dockrell, Glockenspiel Ltd. | Monday, 9-5:00 |
| T1: An Introduction to C++
Robert Murray, AT&T Bell Laboratories | Tuesday, 9-5:00 |
| T2: Applications: InterViews & C++ 2.0
Part A: Programming User Interfaces in C++ With InterViews
Mark A. Linton, Stanford University
Part B: What's New in C++ 2.0
Stanley Lippman, AT&T Laboratories | Tuesday, 9-5:00 |

Opening Session

Wednesday, 9-10:30

- Keynote speech
W. N. Joy, Sun Microsystems
- Parameterized Types for C++
Bjarne Stroustrup, AT&T Bell Laboratories

Technique

Wednesday, 11-12:30

- Building Well-behaved Type Relationships in C++
R. B. Murray, AT&T Bell Laboratories
- Porting from Common Lisp with Flavors to C++
Joseph Eccles, AT&T Bell Laboratories

Databases and File Systems

Wednesday, 2-3:30

- Prototyping Database Applications with a Hybrid of C++ and a 4GL
Ronan Stokes, Glockenspiel, Ltd.
- Open Dialogue: Using an Extensible Retained Object Workspace to Support a UIMS
Andrew Schulert, Kate Erf, Apollo Computer

Building Object-Oriented UNIX-like File Systems in C++
Peter Madany, Doug Leyens, Vince Russo,
Roy Campbell, University of Illinois

Applications

Wednesday, 4-5:30

Applying Object-Oriented Design to Structured Graphics
John M. Vlissides, Mark A. Linton, Stanford University
A C++ Interpreter for Scheme
Vincent F. Russo, Simon M. Kaplan, University of Illinois
GPIO: Extensible Objects for Electronic Design Tools
David Campbell, Russel Edwards, Prakash Reddy,
Roger Scott, Data General Corporation

Experience

Thursday, 9-10:30

C++: From Research to Practice
S. B. Lippman, B. E. Moo, AT&T Bell Laboratories
NAPS - A C++ Project Case Study
C. Berman, R. Gur, AT&T

Parallelism and Simulation

Thursday, 11-12:30

Data-Level Parallel Programming in C++
Thomas M. Breuel, MIT
A Multiprocessor Operating System Simulator
Gary M. Johnston, Roy H. Campbell, University of Illinois
Modelling of Control Systems with C++ and PHIGS
Dag M. Brück, Lund Institute of Technology

Linguistics

Thursday, 2-3:30

Type-safe Linkage for C++
Bjarne Stroustrup, AT&T Bell Laboratories
Implementing a Logic-Based Executable Specification Language in C++
Peter A. Kirsliis, Robert B. Terwilliger, AT&T Bell Laboratories
Debugging and Instrumentation of C++ Programs
Martin J. O'Riordan, Glockenspiel, Ltd.

Libraries

Thursday, 4-5:30

libg++, The GNU C++ Library
Douglas Lea, SUNY Oswego
A Class Library for Darts
Troy Otillo, Cal Poly - SLO
Guide to the C++ Real Library
Jerry Schwarz, AT&T Bell Laboratories
Iris: A Class-Based Window Library
E. R. Gansner, AT&T Bell Laboratories

Call for Papers

Winter 1989 USENIX Conference

San Diego, California

January 30 - February 3, 1989

Papers are requested for formal review as candidates for inclusion in the three day technical session at the 1989 Winter USENIX Conference. Papers that are accepted will be presented at the conference and published in the conference proceedings. The technical sessions provide a forum for the presentation of new research and development related to or based upon the UNIX operating system.

Suggested topics include (but are not limited to):

- Performance analysis and tuning
- New User Interfaces and Applications
- System and Network Security
- Networking and Distributed Services
- RISC versus CISC in UNIX
- Software and System Management tools
- Standards
- Graphics and Electronic Publishing
- Evolution of UNIX for the 1990's

All papers should describe new and interesting work. Acceptance or rejection of a paper will be based completely on the work submitted at the deadline. Submitted papers should consist of a 100 to 300 word abstract in addition to the main body of the paper. Extended abstracts will be conditionally accepted but full papers are preferred. Papers accepted on extended abstracts that do not meet the promise of the abstract will be rejected. Each paper should discuss how this work relates to prior work and provide sufficient detail in the presentation of background material and work to allow referees to perform a consistent comparison to other submitted papers. Concise references of related work should also be included as appropriate. Full papers should be 6-12 single spaced typeset pages and include any abstract, references, or illustrations. For the review process you should submit the highest quality copy you can create. Laser printer output is recommended. The exact format for final papers will be sent to authors of accepted papers.

Four hard copies and one electronic copy of each submitted paper must arrive no later than **October 7, 1988**; this is an absolute deadline. Papers received after that date will not be considered. Papers which clearly do not meet USENIX's standards for applicability, originality, completeness or page length may be rejected with no review. Authors will receive official notification no later than **November 4, 1988**, and final papers are due by **December 5, 1988**.

Please contact one of the program chairs if additional information is required:

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Karen White	Pyramid

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Workshop on Large Installation Systems Administration

**DoubleTree Hotel
Monterey, California**

November 17-18, 1988

In light of last year's successful workshop on Large Installation Systems Administration, Alix Vasilatos will again be chairing a workshop on this subject in Monterey, CA on Thursday and Friday, November 17th and 18th, 1988. There is demonstrable benefit in bringing together system administrators of sites with 100 or more users (on one or more processors) to compare notes on solutions that they have found for a variety of common problems. These include but are not limited to:

- Large file systems (dumps, networked file systems)
- Password file administration
- Large mail system administration
- USENET/News/Notes administration
- Heterogeneous environments (mixed vendor and/or version)
- Load control and batch systems
- Monitoring tools
- Software release to multiple systems
- Output device management

The workshop will focus on short papers and presentations. You do not have to present to attend! Proceedings will be available at the workshop.

Rob Kolstad of Prisma Computers will be the Keynote Speaker. His topic will be "The Evolving Role of the System Administrator."

For details about registration, contact the USENIX Conference Office at (213) 592-3243 or {uunet,ucbvax}!usenix!judy.

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Call for Papers EUUG Spring '89 Conference

**Brussels, Belgium
April 10-14, 1989**

The BUUG will host the Spring '89 European UNIX systems User Group Technical Conference in Brussels. Technical tutorials on UNIX and closely related subjects will be held on Monday and Tuesday, followed by the three day conference with commercial exhibitions. A pre-conference registration pack will be mailed to interested persons in early December.

Call for Papers

The EUUG invite abstracts from those wishing to present their work. Submissions from students are particularly encouraged under the EUUG Student Encouragement Scheme, details of which are available from the Secretariat. All submitted papers will be refereed to be judged with respect to their quality, originality and relevance. Abstracts **MUST** be submitted by post to the EUUG Secretariat. All submissions will be acknowledged. Suggested subject areas include:

- real time
- networking
- security issues
- graphics
- internationalisation
- distributed processing
- fault tolerance
- new architectures
- transaction processing
- window systems and environments
- supercomputing
- standards and conformance tests

Important Dates:

Abstract deadline	November 30, 1988
Acceptance notification	January 15, 1989
Final paper received	February 1, 1989

Tutorial Solicitation

Tutorials are an important part of the EUUG's biannual events, providing detailed coverage of a number of topics. Past tutorials have been taught by leading experts. Those interested in offering a tutorial should contact the EUUG Tutorial Officer as soon as possible.

Additional Information

The Programme Chair will be pleased to provide advice to potential speakers.

If you wish to receive a personal copy of further information about this, and future, EUUG events, please contact the Secretariat.

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Obtaining GNU Software

The GNU Project (GNU's Not UNIX) is developing a complete UNIX compatible software system with freely redistributable source code. The rationale for GNU is explained in the GNU Manifesto. Copies are available in the GNU Emacs distribution and manual, and by request to gnu@prep.ai.mit.edu.

You are encouraged to get GNU software from or with others. GNU software is also available by *ftp* on the DoD/NSF Internet, and by *uucp*; ask gnu@prep for details. If you are unable to use one of these methods, you can use this order form.

___ at \$ 150 = \$ _____	GNU Emacs source code and other software , on 1600bpi tape in <i>tar</i> format. The tape also includes Scheme, T, Hack, Bison, GNU Chess, GDB, and the X window system (Version 10r4).
___ at \$ 150 = \$ _____	GNU C Compiler . Beta test tape, 1600bpi, in <i>tar</i> format. The tape also includes Bison, Gawk, GNU Assembler, X windows (Version 11r2 complete), Flex, GNU Make, and object file utilities.
___ at \$ 175 = \$ _____	GNU Emacs source and other software , cartridge tape for Suns.
___ at \$ 175 = \$ _____	GNU C Compiler and other software , cartridge tape for Suns.
___ at \$ 150 = \$ _____	GNU Emacs source and binary code , on 1600bpi tape in VMS interchange format.
___ at \$ 150 = \$ _____	GNU C Compiler source and binary code , on 1600bpi tape in VMS interchange format.
___ at \$ 15 = \$ _____	GNU Emacs manual , ~300 pages, spiral bound. The manual is phototypeset and offset printed, and includes a reference card.
___ at \$ 60 = \$ _____	Box of six GNU Emacs manuals, each with reference card.
___ at \$ 1 = \$ _____	GNU Emacs reference card .
___ at \$ 5 = \$ _____	Packet of ten GNU Emacs reference cards.
___ at \$ 10 = \$ _____	GDB manual , ~50 pages, side stapled.
___ at \$ 10 = \$ _____	Texinfo manual , ~100 pages, side stapled.
___ at \$ 10 = \$ _____	Termcap manual , ~60 pages, side stapled.
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Broadcast Storms, Nervous Hosts, and Load Imbalances

Paul E. McKenney

Information Sciences and Technology Center
SRI International

ABSTRACT

As equipment connected to local-area networks becomes more complex and diverse, so do possible modes of failure. Innocent-looking "features" of such equipment can easily cause serious disruptions of service to a local-area network.

Some software problems (including broadcast storms, "nervous hosts," and load imbalances) that can arise on Ethernets using the DDN protocol suite are examined herein. The causes of these problems and the sequence of events leading up to them are explored in detail, and some commonly known methods of preventing, diagnosing, and correcting the problems are presented.

Overview

This paper will look at three of the types of problems which afflict local-area networks:

- Broadcast storms
- Nervous hosts
- Load imbalances.

The following sections will look at these problems in some detail, describing their causes, how they can be diagnosed, and how they can be prevented or corrected. Since the broadcast storm is the most complex and the most damaging of these problems, it will be described in considerably more detail.

Broadcast Storms

While a classic broadcast storm occurs when a large number of hosts respond almost simultaneously to a broadcast packet, the effects of a broadcast storm (nearly total denial of network services for an extended period) can be induced by a number of mechanisms. The term "broadcast storm" will be used in this more general sense for the rest of this paper.

Broadcast storms can be caused by continual packet transmission and by inappropriate responses to broadcast packets.

Continual Packet Transmission

Since Ethernet is multiple-access, there is nothing to prevent a host from consuming most of an Ethernet cable's bandwidth by continually transmitting garbage packets. This extreme case can be remedied only by either fixing the software or physically disconnecting the host from the Ethernet.

Note that bugs that cause continual packet transmission can occur in user software just as easily as they can in the kernel. A normal user program on a Sun-3 work station can easily send well over 100 packets per second through a UDP socket. As few as five or ten programs doing this simultaneously on separate work stations (e.g., *rwhod*¹) can do a very good job of congesting an Ethernet.

The Ethernet source address is relatively immune to corruption by software bugs because it is usually stored in a hardware register in the Ethernet interface.² Therefore, keeping a list of the Ethernet addresses of all machines on a network can help pinpoint the

¹ This program periodically broadcasts the list of users currently logged onto the host that it is running on. While this allows users to easily see who is logged onto other machines, it can also produce bursts of heavy traffic.

² The Ethernet source address is not always completely immune to corruption. For example, hosts running DECNET set their Ethernet addresses to a value related to their DECNET node ID under software control.

source of garbage packets. This pinpointing is accomplished by extracting the Ethernet source address from the garbage packet (possibly using Van Jacobson's *tcpdump* program), then looking up the source address in the list to find the offending host. For those who do not wish to maintain such a list manually, we at SRI have written an "etherhostprobe" program that makes a list of Internet addresses and Ethernet addresses of all hosts connected to the local Ethernet that implement address resolution protocol (ARP).

Responding Inappropriately to Broadcast Packets

The classic broadcast storm ensues when several hosts attempt to forward the same datagram over the broadcast medium it came from.

A classic broadcast storm involves Internet protocol (IP) packets and ARP packets. IP packets are the building blocks for the familiar transmission control protocol (TCP), network file system (NFS), and remote procedure call (RPC). ARP packets allow hosts to associate Internet addresses with the corresponding Ethernet addresses.

The following sections will describe a classic broadcast storm in more detail by looking first at the formats of the IP and ARP packets, second at the IP forwarding mechanism, and finally at a (small) example of a classic broadcast storm. This will be followed by some experimental results obtained at SRI and by recommendations for preventing classic broadcast storms.

Ethernet Header Format

All packets on an Ethernet (including IP and ARP packets) have an Ethernet header prefixed to them as follows:

- Six-byte source address
- Six-byte destination address
- Two-byte packet type.

An Ethernet address is typically written in hexadecimal form, separated by colons, e.g., `1c:08:1e:3d:00:0a`. The Ethernet broadcast address is `ff:ff:ff:ff:ff:ff`; a packet with

this as its destination address will be received by all local Ethernet interfaces.

Each Ethernet interface ignores all packets except those whose destination address is either that Ethernet interface's address or the broadcast address. Ethernet packets destined for the broadcast address form the seeds of a broadcast storm.

An Ethernet packet type of `0800` (hexadecimal) indicates that the packet is an IP packet; an Ethernet packet type of `0806` (hexadecimal) indicates that the packet is an ARP packet.

IP Header Format

An IP packet has many fields, but the only one relevant to this discussion is the four-byte IP destination address (see Request For Comments (RFC) 791 for more details). An IP address is typically written in dotted-decimal form, e.g., `10.0.0.51`. Each IP address is divided into a "network part" and a "host part" with the latter part broken down further in a subnetted network (see RFCs 922, 950, and 1027 for details). Table 1 shows how the different classes of nonsubnetted IP addresses are decomposed into network and host parts.

First Byte	Class	Network	Host
0	127	A	1
128	191	B	2
192	223	C	3
224	239	D	1
240	255	E	

Table 1: IP Address Classes

Class D addresses are special multicast addresses (see RFCs 966 and 988), and Class E addresses are reserved for future use. Only Class A, B, and C addresses are relevant to this discussion. (See RFCs 1010 and 1020 for more details on IP address assignment.)

If the host part of the IP address is composed of all 255s (for example, `10.255.255.255`), the IP packet is to be broadcast to all hosts on network 10.³ Unfortunately, this convention was established

³ However, since network 10 does not support the notion of broadcast, this IP packet would be ignored, although an error might be returned via an ICMP packet.

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only fairly recently, so that some older implementations (in particular BSD 4.2) employ the convention that a host part composed of all 0s (e.g., 10.0.0.0) indicates that the IP packet is to be broadcast to all hosts on the network. As will be seen, this historical incompatibility constitutes the trigger that sets off the classical broadcast storm.

A sample new-style IP broadcast packet layered over Ethernet is shown in Table 2. The "IP data" would consist of the headers and data of the higher level protocol (e.g., user datagram protocol, or "UDP") that is layered on top of IP in this packet.

ARP Packet Format

The following fields from an ARP packet are relevant to this discussion (see RFC 826 for more details):

- Sender's Ethernet address
- Sender's IP address
- Target's IP address.

A typical ARP packet might be as shown in Table 3. Here the host (call it Host A) whose

IP address is 193.30.20.10 wants to know the Ethernet address for the host (call it Host B) whose IP address is 193.30.20.11. Since Host A does not know Host B's Ethernet address, the Ethernet destination address is set to the broadcast address so that Host B can receive the packet. When Host B does receive the packet, it will note that the target IP address in the packet matches his own IP address, and will send a reply. Any other host that receives the packet will see that the target IP address in the packet does not match his own, and so will discard the packet.

IP Packet Forwarding

While an Ethernet interface can simply ignore packets that are not addressed to it, a host may be required to process IP packets that are addressed to someone else. For example:

- A host that is acting as a gateway between two networks must forward packets between the networks.
- A host that cannot forward a packet may inform the packet's originator by means of an

	Field	Value
Ethernet Header	Source Address	1c:08:1e:3d:00:0a
	Destination Address	ff:ff:ff:ff:ff:ff
	Packet Type	0800
IP Header	Destination IP Address	193.30.20.255
IP Data		

Table 2: New-Style IP Broadcast Packet

	Field	Value
Ethernet Header	Source Address	1c:08:1e:3d:00:0a
	Destination Address	ff:ff:ff:ff:ff:ff
	Packet Type	0806
ARP Packet	Sender's Ethernet Address	1c:08:1e:3d:00:0a
	Sender's IP Address	193.30.20.10
	Target's IP Address	193.30.20.11

Table 3: ARP Packet

Internet control message protocol (ICMP) packet.

A host must be very careful with packets that are not addressed to it. (See RFC 1009 for a fairly thorough discussion and RFCs 1015 and 1017 for some recent thoughts.)

A host must be even more careful with packets that have been broadcast, as they may have been received by many other hosts. A good principle is to never do anything with a broadcast packet unless a hundred and one hosts can do it at the same time safely on the same Ethernet.⁴ Broadcast storms can occur when this principle is violated.

Both BSD 4.2 and BSD 4.3 violate this principle by refusing to check that the Ethernet destination address is the same as the Ethernet broadcast address (ff:ff:ff:ff:ff:ff). Both BSD 4.2 and BSD 4.3 do check the Internet destination address to determine whether it matches their idea of the Internet broadcast address (in fact BSD 4.3 checks the Internet destination address to see whether it matches any of the currently known Internet broadcast addresses), but there is no guarantee that

- It will not be necessary to add yet another Internet broadcast address at some time in the future, or that

- Some bug that wraps a broadcast Ethernet header around a single-destination Internet packet will not crop up somewhere.

Any check of the link layer (Ethernet in this case) broadcast address must be done at that layer; the results of the check must be available to the network layer (IP in this case), so that the layer interface would have to be modified to implement this check. This could go a long way toward explaining any reluctance the BSD 4.3 maintainers might feel about making this sort of modification.

There is a work-around for BSD 4.2 and BSD 4.3 systems in the form of a kernel variable called *ipforwarding*. Setting this variable

⁴ Some examples of safe actions would be recording the packet on a local disk, responding to the packet if no other host is going to (e.g., if you are the only boot server, then you may respond to broadcast requests for booting), and, of course, discarding the packet.

to 0 will prevent any forwarding of IP packets. This has the (possibly unfortunate) side effect of making the system incapable of acting as a gateway between two networks or subnets. Stock systems have this variable set to 1 by default (thus *enabling* IP forwarding), although a BSD 4.3 system with a single network interface will behave as though it were set to 0 (thus *disabling* IP forwarding).

A Classical Broadcast Storm

We now have the background to examine an example broadcast storm. Consider a small network with a single BSD 4.3 machine (193.30.20.10) whose IP broadcast address has been set to the standard 193.30.20.255, and three BSD 4.2 machines, all of which have *ipforwarding* set to 1. Referring to Figure 1 we see the following sequence of events:

1. At time=0, host 193.30.20.10 broadcasts an IP packet over the network. This packet might look like the one in Table 2.

2. BSD 4.2 hosts 193.30.20.11, 193.30.20.12, and 193.30.20.13 all receive this packet.

3. Since the IP destination address 193.30.20.255 does not match either 193.30.20.0 (the BSD 4.2 broadcast address) or the hosts' own IP addresses, each host decides to forward the packet.

4. Each host looks in its cache of IP-address-to-Ethernet-address translations for the Ethernet address corresponding to 193.30.20.255. Since there is no such host, the lookup will fail. Each host will therefore broadcast an ARP packet over the Ethernet at time=10 in an attempt to find the Ethernet address corresponding to 193.30.20.255. Table 4 shows what this packet might look like for host 193.30.20.11. The three simultaneous ARP packets collide and are therefore lost. Each of the hosts detects the collision, and schedules a retransmission at some random time in the future.

5. At time=30, hosts 193.30.20.11 and 193.30.20.13 retransmit. Again the ARP packets collide, are lost, and the hosts schedule a random retransmission.

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	Field	Value
Ethernet Header	Source Address	1c:08:1e:3d:00:0b
	Destination Address	ff:ff:ff:ff:ff:ff
	Packet Type	0806
ARP Packet	Sender's Ethernet Address	1c:08:1e:3d:00:0b
	Sender's IP Address	193.30.20.11
	Target's IP Address	193.30.20.255

Table 4: Broadcast Storm ARP Packet

6. This time, all three hosts pick different times to retransmit their ARP packets. Since a collision is therefore avoided, the packet is broadcast successfully to all other hosts on the Ethernet.

7. Since there is no actual host with an IP address of 193.30.20.255, there is no reply to the ARP packets. Thus, all three of the hosts receiving the original broadcast IP packet will time out and drop the packet.

The net effect is that one broadcast packet has caused no fewer than eight separate transmissions.

We at SRI conducted larger-scale tests of the classical-broadcast-storm mechanism on our local Ethernet (after hours, of course), which is populated by a large diverse population of hosts, including over one hundred Sun workstations, several Vaxes running BSD 4.3, several more Vaxes running VMS, some Xerox workstations, several IBM PCs, several UNIX machines, and an IBM mainframe.

The broadcast storm was triggered by a burst of *rwhod* packets broadcast on the new-style (all 1s) broadcast address by a Silicon Graphics work station. The first set of trials used a total of 43 *ipforwarding* hosts; each trial generated over 400 packets per second for a period of twenty seconds.

The second set of trials used a total of 23 *ipforwarding* hosts; each of these trials generated over 400 packets per second for a period of ten seconds. Decreasing the number of *ipforwarding* hosts shortens the duration of the broadcast storm commensurately.

The packet rate figures are subject to large errors because of missed interrupts in the measuring hosts and to high collision rates on

the Ethernet. The figures given above almost certainly understate the actual packet rates.

The standard measures for preventing classical broadcast storms are well known, but bear repeating:

- Clear the *ipforwarding* kernel variable in each UNIX host on the network, or
- Upgrade each system to a version that has BSD 4.3 networking.

If you have a BSD 4.3 system with more than one network interface, it is still wise to clear the *ipforwarding* kernel variable (unless it is really needed as a gateway).

Most BSD 4.2 and BSD 4.3 systems can be patched with *adb* to clear the *ipforwarding* variable as follows:

```
cp /vmunix /vmunix.save
adb -w /vmunix
-ipforwarding?*W 0
$q
/etc/reboot
```

Note that the change will not take effect until after the reboot.

SRI experimented with an *ipforwarding* program that can determine whether a host will forward new-style IP broadcast packets. This program must be run on a Sun⁵ that is connected to the same subnet as the host to be tested. This program works by handcrafting a "tickler" IP packet with a single-destination Ethernet header and an new-style broadcast IP header (see Table 5). After sending this packet, the program listens for an ARP packet requesting the Ethernet address that corresponds to the new-style IP broadcast

⁵ The program uses Sun's network interface tap (NIT) to send and receive raw Ethernet packets.

;login:

	Field	Value
Ethernet Header	Source Address	1c:08:1e:3d:00:0a
	Destination Address	1c:08:1e:3d:00:0b
	Packet Type	0800
IP Header	Destination IP Address	193.30.20.255

Table 5: IP-Forwarding "Tickler" Packet

address. If such a packet is heard, this means that the destination host does forward new-style broadcast IP packets.

Note that this program does not induce a broadcast storm, since it "tickles" hosts one at a time.

Other Packet-Response Storms

There are other mechanisms that theoretically can result in a packet-response storm:

- Many reverse ARP (RARP) servers serving the same Ethernet address
- Many network mask request servers serving the same subnet.

In practice, only a few servers (perhaps one or two) would be configured to serve the same hosts, so any "storms" that did occur would likely be very mild or completely unnoticeable.

We at SRI run a script based on Van Jacobsen's *tcpdump* program that captures broadcast traffic, retaining the individual broadcast transactions for one hour. This record is very helpful in ascertaining the cause of a broadcast storm, as one can look at the past hour's broadcast packets and see which machines have participated in the storm and possibly which machine caused it.

Nervous Hosts

A "nervous host" is one that continually attempts to send packets to another host that is down. Since the first step in sending a packet to another host on an Ethernet is to broadcast an ARP packet, a large number of nervous hosts can result in an unusually large number of broadcast packets.

The classic "nervous host" is a UNIX host set up to print on a printer that is down and is

connected directly to the network. Let us assume that the printer has been down for a long time, and that the host has not attempted recently to send a job to that printer.

Then let us also assume that a user queues a print job for the dead printer. As long as the printer is down, the host will repeat the following:

1. The printer daemon (*lpd*) will notice that there is a job to be printed and will initiate the filter process specified in the *printcap* entry for the printer.
2. The filter process will attempt to open a network connection to the printer; since the printer is down, this attempt will fail.
3. The filter process will notify the printer daemon of the failure. However, since the printer could come back up at any time, the filter process will indicate that this is a temporary failure. Therefore, the printer daemon will retry the print job.

Since the printer daemon must do several disk accesses in order to start printing a job, a very large number of nervous hosts would be necessary to affect the Ethernet significantly. However, the considerable volume of broadcast ARP packets can confuse monitoring programs (to say nothing of people!).

A good way to diagnose this problem is to look at a record of broadcast packets. If many of these packets are ARP requests for a printer, it is likely that the printer is down and that there are nervous hosts trying to access it.

The best way to solve this particular problem is to fix your printer, but applications should use *sleep(1)* where necessary to prevent this problem.

Load Imbalances

A load imbalance occurs on local-area networks that consist of several Ethernet segments connected by bridges or gateways when:

- One of the segments has much more traffic than the others, or
- Most of the traffic on one of the segments is not local to that segment. The configuration shown in Figure 2 allows only a single packet at a time to be transmitted between a work station and its server. Much better results may be obtained by running parallel Ethernet cables to split the load, as shown in Figure 3. This configuration allows up to two packets to be transmitted at a time, for example, file server A could transmit a packet to one of its work stations at the same time that file server B is transmitting a packet to one of its work stations.

In general, pairs of hosts that communicate with each other heavily should be placed on the same Ethernet segment.

Running physically parallel Ethernet cables allows hosts to be moved easily from one cable to another, as required by changing patterns of usage.

Note that the load balancing problem may be alleviated by the advent of higher-speed networks, such as the 100 Megabit FDDI, although usage will almost certainly expand to fill the available bandwidth.

Summary

In short, to keep your network healthy, *rwhod* and *ipforwarding* must be disabled (even on BSD 4.3 systems, if they have more than one network interface) and the network load must be distributed with care.

The reader should keep in mind that the forgoing discussion is by no means exhaustive. There are many more interesting problems in the form of subnets, gateways, routing protocols, and other elements of network architecture and operations.

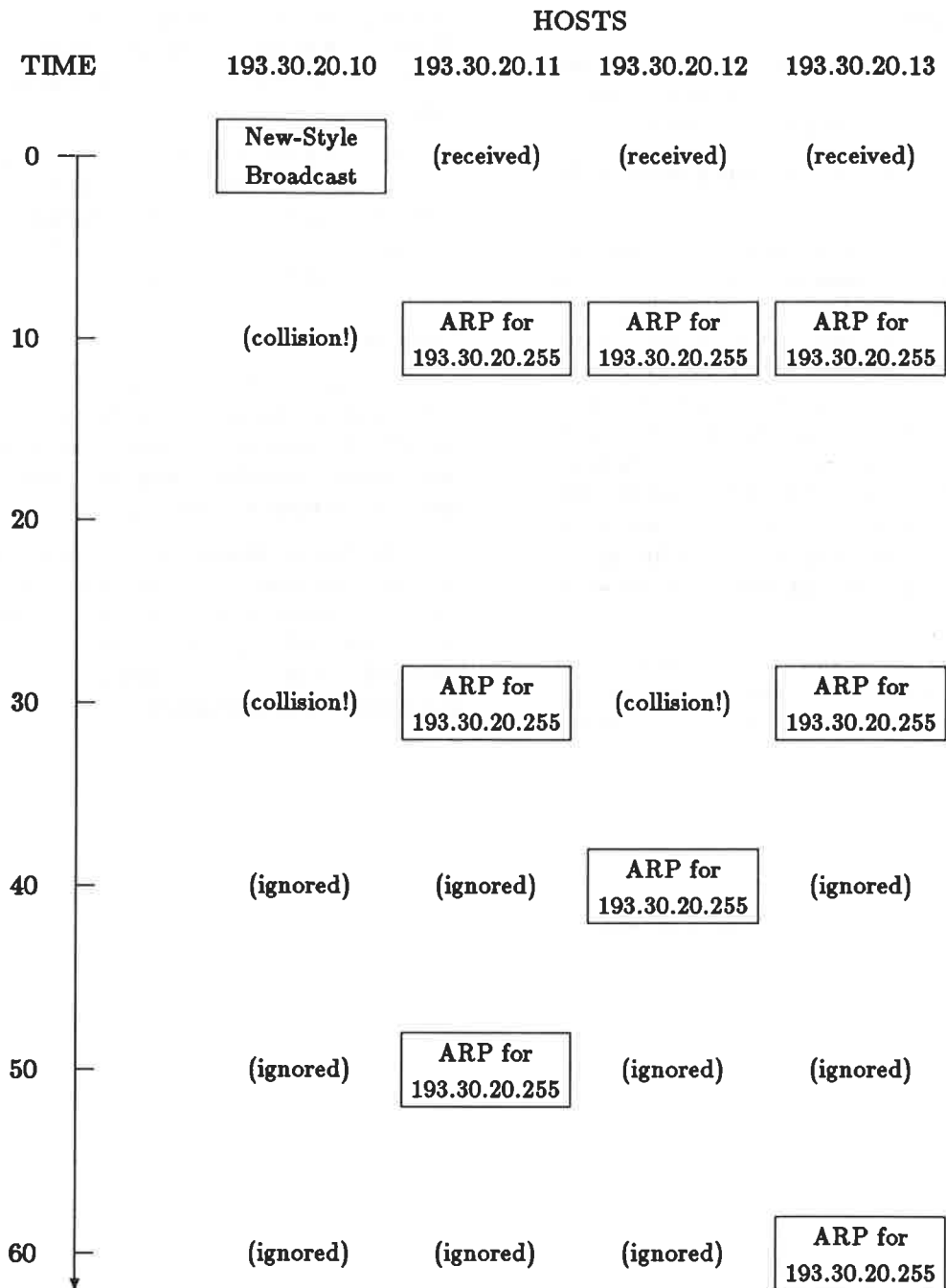


Figure 1: Classical Broadcast Storm

;login:

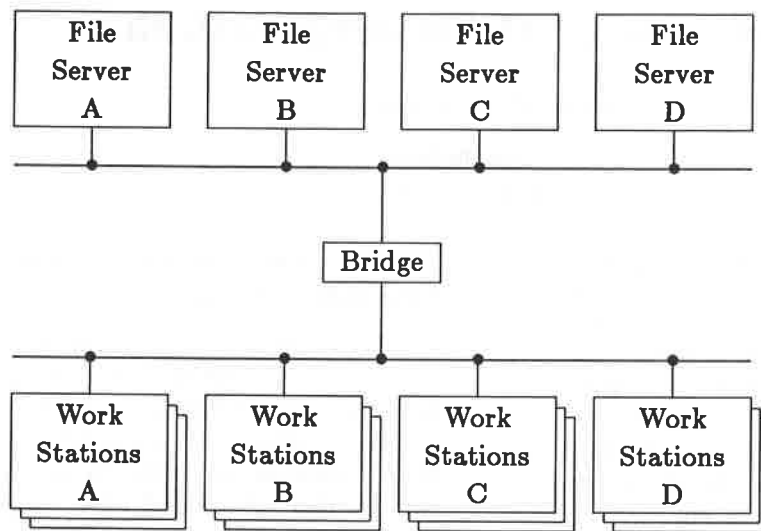


Figure 2: Poor Ethernet Configuration

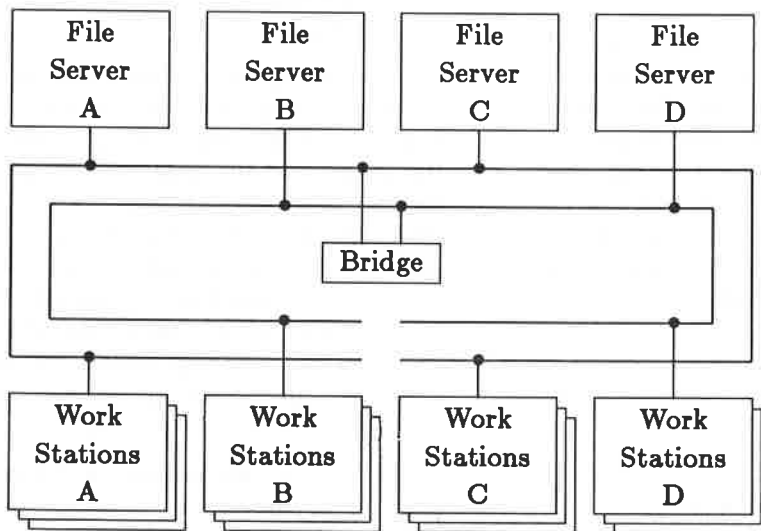


Figure 3: Better Ethernet Configuration

An Update on UNIX Standards Activities

Shane P. McCarron

NAPS International

August 1, 1988

This is the third in a series of reports on standards bodies relating to the UNIX community. Before I start, I would like to take a couple lines to thank all of those readers who were kind enough to drop me a line of either criticism or encouragement; both are greatly appreciated. In the future please feel free not only to comment on the articles here, but also on standards issues. I am more than happy to try and answer any of your questions either individually or through this column.

To business: the most important item to report (from my perspective) is that the USENIX Association has formed a Standards Watchdog Committee. The charter of this group is to keep an eye on as many of the standards efforts as possible, and report the progress of those efforts back to the membership. In addition, the group will be looking for important or contentious decisions, and trying to determine a USENIX position where it seems appropriate. The group will also be looking to you, the members, for input. Everyone has opinions, and the Watchdog Committee, through its standards committee representatives, can serve as a channel to get your ideas to the appropriate groups or can put you in contact with the appropriate people. For more information, please contact:

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Austin, TX 78701
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jsq@usenix.org, uunet!usenix!jsq

As always, the standards bodies have been pretty busy during the past quarter. Busy, that is, in standards body terms. There is often a great deal of heat, but very little light. I have remarked in the past that these committees can take a long time to complete things.

P1003.0 – The POSIX Open Systems Environment Guide

The IEEE 1003.0 working group met on July 12 & 13, 1988 in Denver, Colorado. The purpose of this meeting was to have the group members, who had volunteered during the March meeting to work on certain portions (sub-groups) of the POSIX Open Systems Environment guide document, present their material for review and critique by the group. This was accomplished on day 1 and the morning of day 2. The sub-groups that were discussed included:

1. Operating System
2. Database Management
3. Data Interchange
4. Network Services
5. User Interface
6. Languages
7. Graphics

The remainder of the meeting focused on goals and objectives for the next meeting in October. There was strong consensus within the group that the next goal should be a very rough draft document. Volunteers were assigned to each sub-group above with the purpose of putting into narrative form the material that had been presented. It was also agreed that distribution of this draft prior to the October meeting would be essential in order to allow for good, well thought-out discussion during the meeting.

The group has targeted October, 1989 as a goal for beginning the balloting process. This is aggressive, but possible, assuming that the effort between meetings can be maintained at its present level.

Overall, the meeting was very productive and is drawing more participation from a good cross-section of vendors and users.

P1003.1

The big news this month is, of course, that as of August 22nd the POSIX System Services Interface standard is complete. By the time you read this, final drafts should have been circulated to all of the POSIX working group members, and copies of that draft should be available from the IEEE office in New York. While you can obtain a copy of the final draft now, you would do well to wait for a couple of months and pick up a real, hard-bound version of the standard from the IEEE. To order a copy of the final draft, contact:

IEEE Standards Office
345 E. 47th St.
New York, NY 10017
(212) 705-7091

Since the last installment in this series, the 1003.1 standard has gone through not one, and not two, but three more recirculations. As you may remember, the second recirculation was scheduled to take place in May, and it did. This one went as well as expected, and generated some excellent feedback. The changes from that recirculation were assembled and sent back to the balloting group for review at the end of June. As a result of that recirculation, there were yet more changes to the standard, and those changes had to be recirculated as well. The final recirculation took place at the end of July, and generated no substantial changes. At that point the standard was released to the Technical Editor for final copy editing, and has now been balloted on and approved by the IEEE Standards Board!

This is actually good and bad. It is good for all the reasons you would suppose. It is bad because the standard is not perfect; there are things that shouldn't be in it that are (e.g. some weird timezone stuff and *read()* and *write()* functions that allow broken behavior), and things which should be in it but are not (like *seekdir()* and *telldir()*). Even though the standard is not perfect, at least we now have a foundation upon which additional documents can be based. In the future this standard will be extended and revised, but for now (in combination with Standard C), it's the best thing we have for application portability.

In the meantime, the .1 working group has not been idle. Although the initial work on the Services Interface standard was completed some months ago, there are always new areas to work in. The following is information on developments where they occurred.

Clean Up

There are some issues that were not handled to the satisfaction of the working group in the first cut of the standard. A small group is working on sifting through the unresolved balloting objections (there were several) and identifying those items that can be rectified through modification to the standard. It turns out that many of the unresolved objections were very reasonable items, but were introduced too late in the process to be placed in the standard. Those items will be looked at and possibly added to the standard in a supplement.

Language Independent Description

While little progress has been made in this area by the .1 working group, it turns out that there has been quite a bit of work done by other working groups and technical committees. The /usr/group technical committee on supercomputing, in particular, has produced a Fortran language description of the .1 interface. In the process they have come up with a number of items that can be used by the .1 people to develop their language independent description.

Terminal Interface Extensions

The Working Group looked at the various requirements necessary for a terminal interface standard (a terminal interface standard is something like the Terminal Interface Extensions in the SVID, better known as *curses/terminfo*). The group determined that there is little or no way to get a single interface standard that will satisfy the needs of the entire community. Those people with bit mapped displays can do things better, and we should let them. Those people with block mode terminals have special needs that should not have to be addressed by otherwise portable applications. The majority of users that we are trying to satisfy, those with character based

;login:

terminals, have well defined needs that are already being addressed by existing practice.

What's the solution? Well, none was really proposed, but I would guess that the people in the bit mapped world are going to care a lot more about Open Look and Presentation Manager (bite my tongue) than they are about something based on *terminfo* or *termcap*. For the other 90 percent of the UNIX-using community, while *terminfo* & *termcap* may be what they are used to seeing, it is hardly attractive enough to make them sit up and take notice. They are looking for flashier, better, faster applications, and the traditional interface is not going to be enough. For application developers, the functionality which can be achieved via *terminfo* is fine but hardly adequate for building the products that the user community is coming to expect.

I would guess that the POSIX committees will settle on some subset of the *terminfo* interface as the standard, and that no one will use it. Sure, it will be on every POSIX conformant system, but who cares? It is a lame interface, and someone will come up with a better one soon enough.

New Archive Format

As I mentioned previously, the ISO has asked P1003.1 to come up with a new archive format that will not have the deficiencies of *tar* or *cpio* and will be able to take the security concerns of the P1003.6 group into consideration (I assume that by this they mean access control lists, mandatory access controls, and the like). Little was done on this topic between meetings, but at the July meeting the committee discussed ways to extend the *cpio* archive format to take these things into consideration. While the technical details of this extension are clear, they are also boring. Suffice it to say that the filename field in the archive can be extended through a kludge and that it would be backward compatible.

This met with mixed reactions, and I believe that in the end it will not be used. This discussion (popularly known as Tar Wars) has been very religious and contentious, and I don't think that a format based on either will be able to get popular support from the working group. There is now a small group of people (from both camps) working on another new

format, and I am certain that they will come up with something for the October meeting.

P1003.2 – Shell and Tools Interface

This group is actually a little bit ahead of schedule. Forget all the nasty things I have said about their schedule being too tight and optimistic – they are actually going to do it! You're not as impressed as I am, I can tell. Some people are just never satisfied. Okay, here's some evidence for you.

Functionality was frozen at the March meeting. This means that no additional commands or concepts could be added to the standard. It also means that the working group members were free to concentrate on the content of the draft, instead of looking at new proposals for additional commands all of the time. This has turned out to be very profitable; the draft has been cleaned up to the point where it can be submitted (to the working and corresponding groups) for a mock ballot in September. A mock ballot is just that – a process during which the draft is picked apart as it would be in the balloting process, with changes submitted through formal balloting objections. This may seem a little excessive, but it has proven effective in the past.

Assuming that all goes well, and the objections from the mock ballot are resolved at the October meeting, the group could go to a full ballot as early as January. A less optimistic scenario shows the group working on resolution of the mock ballot for two full meetings, with the real ballot occurring in February or March. Either way, the group is on schedule for a full use standard before the end of 1989.

In addition to this good news, there were a few key decisions made at the July meeting.

This side of the Tar Wars is apparently at an end. There were two aspects to the war – user-program interface and actual archive format. The interface side of it seems to have been settled by the introduction of a command called *pax* (Latin for peace). This command will be able to read and write both types of archives and has an interface that is acceptable to both camps. While this has not been agreed upon by the balloting group, or even by the full working group, the interface is pretty

familiar, and I believe it will be approved with little change.

The group also concentrated on trying to remove anything that might be considered implementation dependent from the draft. This included removing the octal modes from *chmod*, and the signal numbers from *trap* and *kill*. In their place go all of the mnemonic command line arguments that have been in those commands all along, but aren't used by anyone. As a committee member I can see what they are trying to do, and even agree with it. As a user, however, I wish they would have placed requirements that, say, *kill -9* would always map to SIGKILL. At least that way I wouldn't have to fix every shell script I have ever written.

P1003.3 - Testing and Verification

This working group is progressing well on its verification standard for 1003.1. They are planning to have a version to ballot in January or February of 1989. That would make the standard available just about the time that the major vendors are finishing their .1 conformant implementations.

The group has also started supplying liaison people to each of the other working groups. These people, with their experience writing a testing standard for .1, are proving very valuable in designing testable standards.

New POSIX Work Items

In addition to all of the committees you have heard about in past articles, there were several new working groups proposed to the P1003 steering committee.

System Administration

The committee recognizes the need for a standard interface to many of the system administration utilities that we are plagued with. While there was a considerable amount of skepticism exhibited from the members, the steering committee has agreed to let work progress on this topic. Consequently, a PAR was filed by Steve Carter of Bellcore, and the new working group will start meeting in October.

This group has a lot of work ahead of them; the difficulties of designing standard

interfaces to things like *fsck* and *fsdb* may prove impossible. Also, from a system implementor standpoint, I would hate to have the administrative functions I can provide limited by something that a standards committee is going to generate based on existing practice. This is not an area in which there is a huge body of existing applications, so implementors should be allowed to innovate and improve if they like.

On the other hand, the computer users of the world are probably pretty sick of having to learn a new way to enable printers on every system they purchase. For those people, having a standard is going to be a big win. This is one of those times when the saying "be careful what you wish for..." comes into play. The ultimate, generic system administration interface may prove to be so restricted or brain-dead that it is of no use to anyone. The .1 standard was nearly that way.

Networking

Another new working group will be focusing on the services and service interfaces for a networked POSIX conformant system. While the exact charter and goals of this group are not fully established, what they are not trying to do is. They are not trying to overlap the work of the ISO-OSI committees, nor are they trying to supplant the work being done by IEEE 802. Their plan is to spend two years defining the services and service protocols, and maybe an additional year defining interfaces to those protocols.

User Interface Commands

If you have looked closely at the 1003.1 and .2 standards, you will notice that there is nothing in either of them about User Interface. Well, you're not alone, and someone is finally going to do something about it. A sub-group of the Shell and Tools committee has been formed to codify the interface of many of the classic UNIX commands (*vi*, *ed*, etc.). In addition, the group will be defining the user interface aspects of those commands already in the .2 standard which have traditionally had user interfaces as well as their programmatic ones.

This group is going to work somewhat in a vacuum - since there is no standard for

terminal interface, the user interfaces defined are not going to have a way, programmatically, of being put on the screen. *terminfo* will of course work for this, but it is not a standard. Hopefully the .1 committee can get a supplement out regarding this before the .2 subgroup finishes its work describing the utilities.

X/Open

The X/Open group is just about to release version 3 of the X/Open Portability Guide. This set of manuals is a must for any application developer or system implementor planning on marketing products in Europe. Version 3 will encompass all of the .1 standard, but will not contain any of the items proposed in the latest drafts of .2 – that document is too immature. The XPG also has language definitions, database interface specifications, and many other things that a growing programmer needs in the UNIX world.

NBS – Federal Information Processing Standard

I have written about this in each issue of this report, and each time I say that it is almost here. Well, I am done making predictions. The Federal government has a shield that my crystal ball just refuses to penetrate. I have heard recently that the FIPS for the .1 standard is within the Commerce department somewhere, but I have no proof. When it does finally come out, it will be based on a version of the standard that is almost a year out of date. Draft 12 of the .1 standard resembles the final standard about like a caterpillar resembles a butterfly. This is very unfortunate, as the vendors that are serious about selling computers to the Feds are going to have to conform to that standard, and not the real one. Note that while the NBS did try to jump the gun a little bit, they forced the .1 committee to work harder and faster. Without their encouragement the standard may well never have been finished.

Of course, the NBS has indicated that they will start making the FIPS conform to the final standard just as soon as it is out (now, that means). But, given the amount of time it took them to get the first standard out the door, I'm not holding my breath. It could be deep into

1989 before we see a revised FIPS hit the Federal Register's list of announcements.

In the meantime, the NBS is proceeding in its specification of other interim FIPS. Just until there are real standards in these areas, of course, we are going to see FIPS on Shell and Tools, User Interface, System Administration, Terminal Interface Extensions, and probably shoe lacing. The NBS people are very busy cranking out standards that Federal government departments can cite when generating bid requests. Unfortunately, in those cases where the committees aren't far enough along yet, these standards are going to be based on the SVID. And if the SVID is used as a base document by the Feds, you can be sure that it will also be used by any standards committees that come along later and want to "codify existing practice." Just another example of the Federal government guiding the standards community.

The NBS is putting on a series of workshops this fall to address some of these issues, and get input from the community. The first of these workshops, a seminar on "POSIX and other Application Portability Profile Standards" will be September 22nd and 23rd. For more information, contact Debbie Jackson at (301) 975-3295. She will be happy to send you registration materials, as well as give you information about future workshops being put on by the National Bureau of Standards.

X3J11 – ANSI C Language Standard

This standard is pretty important to everyone in the UNIX community. Unfortunately, that means that everyone has to get involved in the development of it, and that takes time. The document has now entered its third public comment period (July 1st → August 31st). From what I gather, the committee will be very reluctant (read "it will never happen") to make any substantive changes to the standard as a result of this period. What they are looking for is affirmation from the public that the changes made in round two were adequate to remove most of the outstanding objections.

The good news here is that the *noalias* keyword has been removed from the draft. This was a very contentious issue, and was

;login:

introduced very late in the process. In simplest terms, `noalias` would allow the programmer to specify that the program, for that statement, would do exactly what it was supposed to do. Pretty silly, when you get right down to it. Anyway, its gone now – like a bad dream.

In addition, a number of simple editorial changes were made. Most of these are transparent, and just made the standard a little more readable. Unfortunately, it is still a standard written by programmers, for programmers, and is a little hard to read. There is even rumor of a *x3speak* program, like the *valspeak* of a few years ago, about to come out in *comp.sources.misc*. This would take any prose and render it senseless through

the addition of legalese. My advice to future readers of the standard is this: Don't go into the water alone. Use the buddy system, and take a reader's guide with you.

Assuming all goes well at the September meeting, the ANSI C Language Standard should be published later this year.

Well, that's about it for this month. Remember, keep those cards and letters coming to:

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ahby@bungia.mn.org

Future Events

EUUG Autumn Conference
Estoril, Portugal, Oct. 3-7

C++ Miniconference
Denver, CO, Oct. 17-21

The Program Chair is Andrew Koenig of AT&T. See page 3.

Large Installation
Systems Administration II
Monterey, CA, Nov. 17-18

The Program Chair is Alix Vasilatos of MIT's Project Athena. See page 6.

Japan UNIX Society
Osaka, Nov. 11-15, Conference & Exhibition
Toyko, Dec. 7-8, UNIX Fair '88

For both events, contact: Ms. Hiroko Tsunoda, Japan UNIX Society, 2-12-505 Hayabusa-cho, Chiyoda-ku, Tokyo 102, +81-3-234-5058

USENIX 1989 Winter Technical Conference
San Diego, Jan. 30-Feb. 3, 1989

See page 5.

EUUG Spring Conference
Brussels, Apr. 10-14, 1989

See page 7.

Long-term USENIX & EUUG Schedule

Jun 12-16 '89 Hyatt Regency, Baltimore
Sep 18-22 '89 Vienna, Austria
Jan 22-26 '90 Omni Shoreham, Washington, DC
Apr 23-27 '90 Munich, W. Germany
Jun 11-15 '90 Marriott Hotel, Anaheim
Jan 21-25 '91 Dallas
Jun 10-14 '91 Opryland, Nashville
Jan 20-24 '92 Hilton Square, San Francisco
Jun 8-12 '92 Marriott, San Antonio

USENIX Association
(A Delaware Non-Stock Corporation)
By-Laws[‡]

November 14, 1983

Article 1: Activities

1.1 Activities

To achieve its purposes, the Corporation may:

1.1.1 Meetings

Conduct general meetings, discussion groups, forums, panels, lectures and other similar programs concerned with the development, exchange and communication of research and technological information and ideas pertaining to UNIX and UNIX-related computer systems.

1.1.2 Publications

Publish through its Newsletter and other publications the results of its members investigations and other information relevant to the purposes of the Corporation.

1.1.3 Software Distribution

Collect software and distribute said software to its members for use on their systems.

1.1.4 License Verification

Verify licenses of members for the purpose of administering the services of the Corporation.

1.1.5 Other Activities

Establish and promote other activities consistent with its purpose for the benefit of its members.

Article 2: Definitions

2.1 Defined Terms

As used herein, the following terms shall have the meanings set forth below:

[‡] There have been several inquiries recently about the Association's By-Laws. Here they are! -PHS

2.1.1 The Corporation

USENIX ASSOCIATION, a Delaware non-profit, non-stock corporation.

2.1.2 Member's Representative

The employee or principal of a Member designated to serve as that Member's official spokesman at any function of the Corporation and to cast that Member's vote on all matters as to which the Member may have the right to vote.

2.1.3 Voting Member

Any Member who has been granted voting rights by Section 3.8.

Article 3: Membership

3.1 Classes of Membership

Four classes of membership are provided. Benefits and qualifications for each class shall be determined by the Board of Directors.

3.1.1 Student Member

Any full time student is eligible to become a Student Member.

3.1.2 Individual Member

Any person who or organization which has a bona fide interest in the purposes of the Corporation is eligible to become an Individual Member.

3.1.3 Institutional Member

Any person who or organization which has a bona fide interest in the purposes of the Corporation is eligible to become an Institutional Member.

3.1.4 Supporting Member

Any person who or organization which has a bona fide interest in the purposes of the Corporation is eligible to become a Supporting Member.

3.2 Application for Membership

An Organization or person desiring to become a Member shall submit a written membership application to the Corporation, addressed to the Secretary or his designated assistant. The completed application shall provide such information as shall from time to time be prescribed by the Board of Directors.

3.3 Qualification as Member

The Board of Directors shall establish procedures for review of each membership application. The applicant shall be notified of approval or rejection within thirty days after receipt of application.

3.4 Obligations of all Members

Each Member shall abide by the By-Laws and the rules and regulations of the Corporation as they may from time to time appear. All Members shall respect licensing obligations.

3.5 Grounds for Loss of Membership

A Member shall lose his membership within thirty days after receiving written notice from the Secretary that the Board shall have determined that the Member has failed to abide by the By-Laws or rules and regulations of the Corporation (such notice to state the basis for revocation of membership).

3.6 Appeal

Within ninety days of the receipt of notice sent pursuant to section 3.5, the recipient Member may appeal in writing (addressed to the President) to the Board of Directors to have the notice set aside. The only bases upon which such appeal may be made shall be:

3.6.1 Invalid Grounds

Proof satisfactory to the Board that the ground(s) set forth in the notice is (are) not valid, or

3.6.2 Extenuating Circumstances

A reasonably detailed statement of extenuating circumstances. The Board of Directors shall act upon an appeal within ninety days of its receipt and shall notify the appellant in writing of its decision within thirty days thereafter.

3.7 Withdrawal

A member may voluntarily withdraw from the Corporation at any time by giving written notification to the Secretary signed by the Member or Member's Representative of the desire to so withdraw. Such withdrawal shall become effective upon receipt thereof by the Secretary.

3.8 Rights of Members

The right to vote for the election of members of the Board of Directors and officers and to vote on all issues is conferred solely upon Individual, Institutional and Supporting Members. Only a Voting Member or Member's Representative shall be eligible to be a member of the Board of Directors or to hold elective office in the Corporation.

3.9 Membership Dues

The amount of dues to be paid by members of the Corporation shall be set by the Board of Directors. Dues shall be due and payable on a schedule set by the Board.

Article 4: Directors

4.1 Powers

All corporate powers shall be exercised by the Board of Directors, except as otherwise expressly provided by law or by the Certificate of Incorporation or by these By-Laws, but the directors shall act only as a Board and the individual directors shall have no power as such. Among such powers are:

4.1.1 Corporate Policy

The Board of Directors shall develop, determine and prosecute corporate policy.

4.1.2 Decisions of Members

The Board of Directors shall interpret and implement the decisions of the Members.

4.1.3 Budget

The Board of Directors shall approve the Corporation's annual budget and engage an accounting firm to examine the Corporation's financial records and to prepare all necessary tax returns and information statements.

4.1.4 Vacancies

The Board of Directors shall fill all vacancies in any office or on the Board of Directors for the unexpired term of the previous holder of such office or seat on the Board of Directors, provided that any officer or director so elected shall be subject to removal by the Members and the Board of Directors shall not have any power to reelect any officer or director who may have been removed by the Members. If there is a vacancy in the office of the President, the Vice President shall assume that office and the Board of Directors shall fill the thus vacated office of Vice President.

4.2 Number, Term of Office and Qualification

The number of directors of the Corporation shall be eight. The Corporation's President, Vice President, Secretary and Treasurer shall automatically become directors when elected to their office. In addition to the aforementioned officers, the Board of Directors shall have four other directors. Any eligible person may be reelected as a director one or more times. The term of office of each director shall begin at the Annual Meeting following his election and end at the Annual Meeting of the next even numbered year. The term of office of any director may be terminated at any time, with or without cause, by an affirmative vote of 2/3 of the votes cast by Members entitled to vote and who shall have voted thereon, but in no case shall an officer or director be removed unless 1/3 of the total membership entitled to vote casts votes in favor of the removal.

4.3 Resignations

Any Director may resign at any time, in writing, by notifying the Board of Directors or the President or the Secretary of the Corporation. Such resignation shall take effect at the time therein specified, and, unless otherwise specified, the acceptance of such resignation shall not be necessary to make it effective.

4.4 First Meeting

Each duly elected Board of Directors shall hold its first meeting for the purpose of organization and the transaction of other business, if a quorum be present, without notice of such meeting, on the same day and at the same place as the Annual Meeting next occurring after the election of said Board of Directors or as soon as practicable after such Meeting.

4.5 Regular and Special Meetings

Meetings of the Board of Directors shall be held at such places, within or without the State of Delaware, and times as may be fixed from time to time by resolution of the Board of Directors. The President or the Secretary may call, and upon written request signed by any three directors the Secretary shall call, special meetings of the Board of Directors. Any Meeting of the Board of Directors may be held within or without the State of Delaware, as designated in the notice or waiver of notice of such meeting.

4.6 Notice of Meetings

Notice of meetings of the Board of Directors shall be in writing, signed by the President or the Secretary, and shall be sent to each director by mail addressed to his last known address, being placed into the mail at least ten days before the time designated for such meeting.

4.7 Waiver of Notice

Any meeting of directors and any action otherwise properly taken thereat shall be valid if notice of the time, place and purposes of such meeting shall be waived in writing before, at

or after such meeting by all directors to whom timely notices were not sent as provided in these By-Laws.

4.8 Consent

Any other provisions of these By-Laws to the contrary notwithstanding, any action required or permitted to be taken at any meeting of the Board of Directors or of any committee may be taken without a meeting, if prior to such action a written consent thereto is signed by all members of the Board or of such committee, as the case may be, and such written consent is filed with the minutes of proceedings of the Board of Directors.

4.9 Quorum

Four directors in office, personally present, shall be necessary and sufficient to constitute a quorum for the transaction of business at any meeting of the Board of Directors, but a smaller number may adjourn any such meeting to a later date. Notice of such adjourned meeting shall be given by mail to each director not present at such meeting, the notice being addressed to his last known address and placed into the mail at least ten days before the time designated for such meeting.

4.10 Action by Majority Vote

Except as otherwise expressly required by law or by these By-Laws, the act of 4 or more directors who are a majority of the directors present at a meeting at which a quorum is present shall be the act of the Board of Directors.

4.11 Vote to Fill Vacancies

Any vacancy in the Board of Directors may be filled for the unexpired term, in accordance with section 4.1.4 by a majority vote of the remaining directors, though less than a quorum.

4.12 Submission of Matter to Mail Vote of the Members

The Board of Directors may submit any matter to a mail vote of the Members, when required or deemed advisable or desirable by the Board of Directors. Any such mail vote shall be pursuant to Article 9. The

membership vote shall be binding upon the Board of Directors only if at least 1/3 of all members entitled to vote upon the issue shall vote. If less than 1/3 of voting members vote, the issue may be decided by the Board of Directors.

Article 5: Officers

5.1 Officers

The officers of the Corporation shall be a President, a Vice President, a Secretary and a Treasurer, each to have such duties or functions as are provided in these By-Laws or as the Board of Directors may from time to time determine. One person may not hold any two or more of the foregoing offices.

5.2 Nomination and Elections

Nominations and elections shall be in accordance with Article 7.

5.3 Term

The term of office of each officer shall begin at the Annual Meeting following his election and end at the Annual Meeting of the next even numbered year. The term of any officer may be terminated at any time, with or without cause, by an affirmative vote of 2/3 of the votes cast by Members entitled to vote and who shall have voted thereon, but in no case shall an officer be removed unless 1/3 of the total membership entitled to vote casts votes in favor of the removal.

5.4 Resignations

Any officer may resign at any time, in writing, by notifying the Board of Directors or the President or the Secretary of the Corporation. Such resignation which automatically includes resignation from the Board of Directors, shall take effect at the time therein specified, and, unless otherwise specified, the acceptance of such resignation shall not be necessary to make it effective.

5.5 Vacancies

A vacancy in any office caused by death, resignation, removal, disqualification or other cause may be filled in accordance with section 4.11 for the unexpired portion of the term by the

Board of Directors at any regular or special meeting.

5.6 The President

The President shall be the chief executive officer of the Corporation and shall have general supervision over the affairs of the Corporation, subject, however, to the control of the Board of Directors. He shall, if present, preside at all Annual Meetings, and at all meetings of the Board of Directors. In general, he shall perform all the duties incident to the office of the chief executive officer of a corporation and such other duties as are provided for in these By-Laws and as from time to time may be assigned to him by the Board of Directors.

5.7 The Vice President

At the request of the President, or in his absence, the Vice President shall perform all the duties of the President and in so acting shall have all the powers of and be subject to all the restrictions upon the President. The Vice President shall perform such other duties as may from time to time be assigned to him by the President or by the Board of Directors.

5.8 The Secretary

The Secretary shall act as Secretary of all meetings of the Board of Directors, and of the Members of the Corporation, and shall keep the minutes thereof in the proper book or books to be provided for that purpose; he shall cause all notices required to be given by the Corporation to be duly given and served; he shall have charge of the other books, records and papers of the Corporation; he shall cause the reports, statements and other documents required by law to be properly kept and filed; he shall see that a current list of Members is maintained; he shall be responsible for processing membership applications; and he shall, in general, perform all the duties incident to the office of Secretary and such other duties as may from time to time be assigned to him by the Board of Directors or by the President.

5.9 The Treasurer

The Treasurer shall collect, and keep account of all moneys received and expended for the use of the Corporation; he shall deposit sums received by the Corporation in the name of the Corporation in such depositories as shall be approved by the Board of Directors.

Article 6: Committees

6.1 Committees

By a majority vote, the Board of Directors may from time to time create or terminate standing and ad hoc committees and may determine the names of such committees and the qualification of the members of such committees; and, to the extent permitted by law, may delegate the powers and duties of the Board of Directors to such other committees, and, to such extent, may otherwise determine such powers and duties. The Board of Directors may elect the members of such committees or may authorize the President and/or any other officer or officers to select the members of any such committee.

Article 7: Election of Officers and Directors

7.1 Nominations

No later than nine months preceding the Annual Meeting in every even numbered year, the Board of Directors shall notify Members of the names of Voting Members to serve as a Nominating Committee. Such Committee shall present names of candidates for each Officer and for the Directors to the Members for election. Nominations shall close six months after the date of notification to the members of the composition of the Nominating Committee. Nominations for each Office and Directorship may also be made by any five members. All nominations must bear the signature of at least five Voting Members.

7.2 Elections

Whenever the Officers or Directors are to be elected by the Members, they shall be elected by a plurality of the votes by mail ballot by the

members entitled to vote in the election. Within four weeks following the close of nominations, the Secretary shall cause to be compiled and mailed to all Voting Members a ballot which includes a brief summary of the qualifications of each candidate. The balloting shall be conducted in accordance with the provisions of Article 9. The newly elected Officers and Directors will be informed within one week of the results of the election and the date their term begins.

Article 8: Annual Meeting

8.1 Date of Meeting

The date of the Annual Meeting shall be established by the Board of Directors. At least one month in advance of the meeting date the Board of Directors will notify the Members of the date and time of the Annual Meeting.

Article 9: Voting

9.1 Mail Voting

All voting by the Members shall be conducted by mail.

9.2 Eligibility

Except as provided by law, every Voting Member of record as of the date of entry of a ballot into the mails shall be entitled to one vote.

9.3 Voting Procedures

On all questions to be submitted to a ballot of the Members, the Secretary shall designate a date for the ballot to be placed in the mails. Each ballot must bear a due date not less than two nor more than four weeks after the date of entry of the ballot into the mails. The ballots will be counted within two weeks following the due date. No ballots received after that time will be counted, regardless of postmark. The results of the vote will be announced immediately to the Board of Directors.

9.4 Authentication of Ballots

The Board of Directors shall establish procedures to authenticate the ballots.

Article 10: Contract, Checks, Drafts, Bank Accounts, etc.

10.1 Execution of Contracts

The Board of Directors, except as otherwise provided in these By-Laws, may prospectively or retroactively authorize any officer or officers, agent or agents, in the name and on behalf of the Corporation to enter into any contract or execute and satisfy any instrument, and any such authority may be general or confined to specific instances. Any contract whose dollar value exceeds an amount set by the Board of Directors must be specifically authorized for that value by the Board of Directors.

10.2 Checks, Drafts, etc

All checks, drafts and other orders for payment of money out of the funds of the Corporation, if less than a limit established by the Board of Directors, shall be signed on behalf of the Corporation by any one officer, normally the Treasurer. For amounts equal to or greater than the established limit, said instruments shall be signed by two Officers.

10.3 Deposits

The funds of the Corporation not otherwise employed shall be deposited from time to time to the order of the Corporation in such banks, trust companies or other depositories as the Board of Directors may select.

Article 11: Books and Records

11.1 Books and Records

There shall be kept at a place to be designated by the Treasurer correct books of account of all the business and transactions of the Corporation. If the books and records are to be kept at a place other than the principal place of employment of the Treasurer, Treasurer shall notify the President and Secretary in writing of the location of said books and records.

Article 12: Seal

12.1 Seal

The Board of Directors shall provide a corporate seal which shall be in the form of a circle and shall bear the full name of the Corporation and the year of its incorporation.

Article 13: Amendments of By-Laws

13.1 Amendments by Members

These By-Laws, or any one or more of the provisions thereof, may be amended by changing, altering, suspending, supplementing or repealing the same, by an affirmative vote of 2/3 of the votes cast by Members entitled to vote and who shall have voted, but only in accordance with a proposed amendment duly published and mailed to Voting Members at least thirty days prior to the date of entry of the ballot into the mails. In no case shall an amendment by members be carried by a vote of less than 1/3 of total membership entitled to vote. Conduct of voting shall be in accord with Article 9.

13.2 Amendments by Directors

These By-Laws or any one or more of the provisions thereof may, except for this article, also be amended by changing, altering, suspending, supplementing or repealing the same; by the Board of Directors at any duly constituted regular or special meeting of the Board of Directors. Such an amendment shall require an affirmative vote by at least two-thirds of the entire Board of Directors. Any amendment of these By-Laws by the Board of Directors shall at all times be subject to

rescission by the Members. The Board of Directors shall not have any power to readopt any amendment which may have been rescinded by the Members. When the Board of Directors proposes a change to the By-Laws, written notice of the proposed change, including the vote, the proposed change, and pertinent reasons for the change must be distributed by the Secretary to the Members by first-class mail. Negative responses to the proposed change from the Members shall be directed to the Secretary. Thirty calendar days after the mailing the Secretary will tabulate the responses from Members, and the amendment will take effect if fewer than 25 percent of the Members, of mailing record date, have objected. If 25 percent or more object, the amendment shall not take effect until the members have voted on rescinding the by-law. The vote to rescind shall be in accordance with section 13.1.

Article 14: Compensation of Officers and Directors

14.1 Compensation of Officers and Directors

No part of the income of the Corporation shall inure to the benefit of any Member, Director, or Officer of the Corporation, or any private individual (except that reasonable compensation may be paid for services rendered to or for the Corporation affecting one or more of its purposes), and no Member, Director, or Officer of the Corporation or any private individual shall be entitled to share in the distribution of any of the assets on dissolution of the Corporation.

;login:

Staff Changes

After the San Francisco meeting, Emma Reed, the Association's Membership Secretary, retired. She and her husband, Al, have moved from the Bay Area to California's Central Valley, near Fresno. After years of frenetic questions from members, we hope Emma and Al have a long and peaceful retirement. We will miss the twinkle in her eye.

The Association's new receptionist is Mrs. Eeva McFeely.

The Association has lured away the Journals Manager from the University of California Press. On August 1, Ellie Young (*usenix!ellie*) became Deputy Executive Director. She will act as Peter's left brain, and will be responsible for, among other things, *;login:* and the various workshop proceedings. She will also be in charge of some special projects, for example, the Association's public relations efforts and the ongoing FaceSaver project.

Publications Available

The following publications are available from the Association Office. Prices and overseas postage charges are per copy. California residents please add applicable sales tax. Payment **must** be enclosed with the order and **must** be in US dollars payable on a US bank.

The EUUG Newsletter, which is published four times a year, is available for \$4 per copy or \$16 for a full-year subscription.

The July 1983 edition of the EUUG Micros Catalog is available for \$8 per copy.

We hope to have EUUG tapes and conference proceedings available shortly.

Conference and Workshop Proceedings

Meeting	Location	Date	Price	Overseas Mail	
				Air	Surface
USENIX	San Francisco	Summer '88	\$20	\$25	\$5
C++ Workshop	Santa Fe	November '87	20	25	5
Graphics Workshop IV	Cambridge	October '87	10	15	5
USENIX	Wash. DC	Winter '87	10	25	5
Graphics Workshop III	Monterey	December '86	10	15	5

4.3BSD Manuals

The USENIX Association now offers all members of the Association the opportunity to purchase 4.3BSD manuals.[†]

The 4.3BSD manual sets are significantly different from the 4.2BSD edition. Changes include many additional documents, better quality of reproductions, as well as a new and extensive index. All manuals are printed in a photo-reduced 6"×9" format with individually colored and labeled plastic "GBC" bindings. All documents and manual pages have been freshly typeset and all manuals have "bleed tabs" and page headers and numbers to aid in the location of individual documents and manual sections.

A new Master Index has been created. It contains cross-references to all documents and manual pages contained within the other six volumes. The index was prepared with the aid of an "intelligent" automated indexing program from Thinking Machines Corp. along with considerable human intervention from

Mark Seiden. Key words, phrases and concepts are referenced by abbreviated document name and page number.

While two of the manual sets contain three separate volumes, you may only order complete sets.

The costs shown below do not include applicable taxes or handling and shipping from the publisher in New Jersey, which will depend on the quantity ordered and the distance shipped. Those charges will be billed by the publisher (Howard Press).

Manuals are available now. To order, return a completed "4.3BSD Manual Reproduction Authorization and Order Form" to the USENIX office along with a check or purchase order for the cost of the manuals. You **must** be a USENIX Association member. Checks and purchase orders should be made out to "Howard Press." The manuals will be shipped to you directly by the publisher.

Manual	Cost*
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Programmer's Supplementary Documents, Volume 1	
Programmer's Supplementary Documents, Volume 2	
System Manager's Manual (1 volume)	\$10.00

* Not including postage and handling or applicable taxes.

4.2BSD Manuals are No Longer Available

[†] Tom Ferrin of the University of California at San Francisco, a former member of the Board of Directors of the USENIX Association, has overseen the production of the 4.2 and 4.3BSD manuals.

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4.3BSD Manual Reproduction Authorization and Order Form

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Local User Groups

The USENIX Association will support local user groups by doing an initial mailing to assist the formation of a new group and publishing information on local groups in ;login:. At least one member of the group must be a current member of the Association.

CA - Fresno: the Central California UNIX Users Group consists of a *uucp*-based electronic mailing list to which members may post questions or information. For connection information:

Educational and governmental institutions:

Brent Auernheimer (209) 294-4373
brent@CSUFresno.edu or csufres!brent

Commercial institutions or individuals:

Gordon Crumal (209) 875-8755
csufres!gordon (209) 298-8393

CA - Los Angeles: the Los Angeles UNIX Group meets on the 3rd Thursday of each month in Redondo Beach.

Drew Bullard (213) 535-1980
{ucbvax,ihnp4}!trwrb!bullard

Marc Ries (213) 535-1980
{decvax,sdcrdcf}!trwrb!ries

CO - Boulder: meets monthly at different sites.

Front Range UNIX Users Group
USENIX Association Exhibit Office
5398 Manhattan Circle
Boulder, CO 80303

John L. Donnelly (303) 499-2600
{boulder,usenix}!johnd

FL - Coral Springs:

S. Shaw McQuinn (305) 344-8686
8557 W. Sample Road
Coral Springs, FL 33065

FL - Melbourne: the Space Coast UNIX Users Group meets at 8pm on the 3rd Wednesday of each month at the Florida Institute of Technology.

Alex Stover (305) 724-3962
codas!lola!als

Bill Davis (305) 242-4449
bill@ccd.harris.com

FL - Orlando: the Central Florida UNIX Users Group meets the 3rd Thursday of each month.

Mike Geldner (305) 862-0949
codas!sunfla!mike

Ben Goldfarb (305) 275-2790
goldfarb@hcx9.ucf.edu

Mikel Manitijs (305) 869-2462
{codas,attmail}!mikel

FL - Tampa Bay: the Tampa UNIX Users Group meets the 1st Thursday of each month, alternately in Largo and Tampa.

Scott Stone (813) 974-3307
uflorida!usfvax2!stone, stone@usf.edu

Bill Hargen (813) 530-8655
{codas,usfvax2}!pdn!hargen

George W. Leach (813) 530-2376
uunet!pdn!reggie

GA - Atlanta: meets on the 1st Monday of each month in White Hall, Emory University.

Atlanta UNIX Users Group
P.O. Box 12241
Atlanta, GA 30355-2241

Marc Merlin (404) 442-4772
Mark Landry (404) 365-8108

MI - Detroit/Ann Arbor: meets the 2nd Thursday of each month in Ann Arbor.

William Bulley (313) 995-6211
web@applga.uucp

Rich McGill (313) 971-5950
rich@oxtrap.uucp

Steve Simmons (313) 426-8981
scs@lokkur.uucp

MI - Detroit/Ann Arbor: dinner meetings the 1st Wednesday of each month.

Linda Mason (313) 855-4220
michigan!usr/group
P.O. Box 189602
Farmington Hills, MI 48018-9602

MN - Minnetonka: meets the 1st Wednesday of each month.

UNIX Users of Minnesota
545 Ashland Avenue #3
St. Paul, MN 55102

;login:

Scott Anderson (612) 688-0089
scott@questar.mn.org

MO - St. Louis:

St. Louis UNIX Users Group
Plus Five Computer Services
765 Westwood, 10A
Clayton, MO 63105

Eric Kiebler (314) 725-9492
ihnp4!plus5!sluug

NE - Omaha: meets on the 2nd Thursday of each month.

/usr/group nebraska
P.O. Box 44112
Omaha, NE 68144

Sukan Makmuri (402) 422-8367
ihnp4!ugn!root

New England - Northern: meets monthly at different sites.

Emily Bryant (603) 646-2999
Kiewit Computation Center
Dartmouth College
Hanover, NH 03755

David Marston (603) 883-3556
Daniel Webster College
University Drive
Nashua, NH 03063
decvax!dartvax!nneuug-contact

NJ - Princeton: the Princeton UNIX Users Group meets monthly.

Pat Parseghian (609) 452-6261
Dept. of Computer Science
Princeton University
Princeton, NJ 08544
pep@Princeton.EDU

NY - New York City:

Unigroup of New York
G.P.O. Box 1931
New York, NY 10116

Ed Taylor (212) 513-7777
(attunix,philabs)!pencom!taylor

New Zealand:

New Zealand UNIX Systems User Group
P.O. Box 13056
University of Waikato
Hamilton, New Zealand

OK - Tulsa:

Pete Rourke
\$USR
7340 East 25th Place
Tulsa, OK 74129

PA - Philadelphia: the UNIX SIG of the Philadelphia Area Computer Society (PACS) meets the morning of the 3rd Saturday of each month at the Holroyd Science Building, LaSalle University.

G. Baun, UNIX SIG
c/o PACS
Box 312
La Salle University
Philadelphia, PA 19141

(ihnp4,cbosgd,rutgers)!{bpa,cbmvax}!
temvax!pacsbb!{gbaun,whutchi}

TX - Dallas/Fort Worth:

Dallas/Fort Worth UNIX Users Group
Seny Systems, Inc.
5327 N. Central, #320
Dallas, TX 75205

Jim Hummel (214) 522-2324

TX - San Antonio: the San Antonio UNIX Users (SATUU) meets the 3rd Wednesday of each month.

Jeff Mason (512) 494-9336
Hewlett Packard
14100 San Pedro
San Antonio, TX 78232
gatech!petrol!hpsatb!jeff

WA - Seattle: meets monthly.

Bill Campbell (206) 232-4164
Seattle UNIX Group Membership Information
6641 East Mercer Way
Mercer Island, WA 98040
uw-beaver!tikal!camco!bill

Washington, D.C.: meets the 1st Tuesday of each month.

Washington Area UNIX Users Group
2070 Chain Bridge Road, Suite 333
Vienna, VA 22180

Samuel Samalin (703) 448-1908

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